

ABSTRACT OF THE DISCLOSURE

A method of building systematically a multi-dimensional (n, D, L) circular trellis coded modulation (CTCM) encoder with properties of optimal energy efficiency, strong tail biting and maximum minimum distance (d_{\min}) of trellis paths is disclosed. In addition, a communication system for use in a power limited channel application is disclosed comprising a circular trellis coded modulation (CTCM) encoder with permuted state structure for encoding based on a circular trellis path associated with a sequence of digital information bits and a set of simplexes identified for the path from a multi-dimensional signal constellation; a transmitter coupled to said CTCM encoder for transmitting said sequence of channel symbols over said channel; a receiver for receiving a transmission from said transmitter including said sequence of channel symbols and any noise induced therein; and a CTCM decoder coupled to said receiver for decoding the received transmission without knowledge of the starting state of the circular trellis path of the CTCM encoder to recover the sequence of information bits. Apparatus and methods of encoding and decoding are also disclosed utilizing a combination of circular trellis-coded modulation with permuted state structure and simplex signal constellation techniques for use in the digital communication system.